Dundee Discussion Papers in Economics 216

Chalkley, Martin; McVicar, Duncan

Publication date:
2008

Dundee Discussion Papers in Economics

Choice of Contracts in the British National Health Service: An Empirical Study

Martin Chalkley and Duncan McVicar

Department of Economic Studies,
University of Dundee,
Dundee.
DD1 4HN

Working Paper
No. 216
September 2008
ISSN:1473-236X

Choice of Contracts in the British National Health Service: An Empirical Study[1]

Martin Chalkley
Department of Economic Studies
University of Dundee

Duncan McVicar
School of Management and Economics
Queens University Belfast

This version: November 26, 2007

[1]The support of the Economic and Social Research Council (ESRC) is gratefully acknowledged. The work was funded by ESRC award numbers L114251005 and R000236723. We would like to thank Jim Malcomson, Ray O'Brien, Bill Rogerson, Tom McGuire, Albert Ma and Robert Porter for their comments and suggestions. We are grateful to Ray Robinson, James Raftery and Sean Forest for making available the results of their telephone survey data.

Abstract

Following major reforms of the British National Health Service (NHS) in 1990, the roles of purchasing and providing health services were separated, with the relationship between purchasers and providers governed by contracts. Using a mixed multinomial logit analysis, we show how this policy shift led to a selection of contracts that is consistent with the predictions of a simple model, based on contract theory, in which the characteristics of the health services being purchased and of the contracting parties influence the choice of contract form. The paper thus provides evidence in support of the practical relevance of theory in understanding health care market reform.

JEL classification: I11

Keywords: health services, British NHS, physician agency, financial incentives.

1 Introduction

The British National Health Service (NHS) provides health care that is funded from general taxation and free at the point of delivery for the vast majority of the UK population. Prior to 1990 responsibility for both planning, financing and delivering hospital services in a given geographical area rested with organisational units called *Health Authorities*. Following major reforms in 1990, which are described in detail in Robinson and Le Grand (1993), the roles of planning and financing (purchasing) were separated from responsibility for delivering services (providing). Purchasing was delegated to reformed Health Authorities and some newly empowered[1] general medical practitioners (GPs), whilst provision of services was primarily made the responsibility of hospitals given the status of what was termed an NHS Trust. The relationships between purchasers and providers were governed by contracts with purchasers and providers free, within limits, to determine the precise form of those contracts. The NHS in this period of purchaser-provider contracting, therefore, provides a rare opportunity to observe contract *choice* in the context of health care. When faced with a new environment of contractual negotiation did the newly empowered purchasers of health services behave as economic theory predicts?

The specific arrangements that are the focus of this paper were phased out in 1997 but the issues that we explore continue to be relevant, both to the present day NHS and to other health care systems. For example, the NHS has now moved to a system in which the form of the contract between purchasers (now termed *Primary Care Trusts*) and providers is centrally prescribed (see Dixon, 2004), but the 1990-1997 period allows us to infer how the contracting parties might have behaved in the absence of this constraint on contract choice. The same is true for other countries where contract choice is constrained, the details of which can be found in Langenbrunner *et*

[1] General practitioners with this power were termed *fundholders* or *fundholding GP practices.* In our data all GPs acting as purchasers must have had fundholding status.

al (2005).

Whilst there were variations in the exact terms, the contracts used in the 1990-1997 period took one of four forms, distinguished from one another according to which observable variables payment was conditioned on. We use two sources of data to examine whether the observed selection of contracts conforms with the predictions of a simple model, based on contract theory, in which the characteristics of the health services being purchased and the characteristics of the contracting parties influence the choice of contract form. We find evidence from both data sets of contracts being selected consistently with the predictions of that simple model.

The theoretical background for this paper is contract theory as applied to the purchase of health services. That theory has emphasised the potential costs and benefits that arise when a purchaser conditions payment either on the number of patients treated alone, for which the simplest arrangement is a fixed price contract, or on the cost of treatment, for which the simplest arrangement is cost reimbursement. In this approach, the choice of contract is modelled as a reaction on the part of the purchaser to what McGuire (2000) terms *physician agency*. One trade-off, described extensively by Ma (1994) and Chalkley and Malcomson (2000), is between the strong incentives to control cost that result from fixed prices and the incentives towards quality of service that result from cost reimbursement. According to this literature the form of contract that will most closely deliver what the purchaser requires is sensitive to the degree of concern that providers have for their patients, whether patients are free to choose which provider they visit and the extent to which constraints limit the ability of providers to meet demand. When the cost of a service being provided is unknown *ex ante* a further issue that arises in the context of fixed prices is that, to ensure service delivery against adverse shocks, it is necessary to set a high price and in such circumstances it may be optimal to adopt a cost sharing arrangement, e.g.

of the kind considered in the context of the US Medicare system by Chalkley and Malcomson (2002).

Contracts in which payment is conditioned on both the number of patients treated and the cost of treatment feature amongst the four forms of contract observed post 1990 in the NHS but, in addition, some contracts involved only a fixed monetary transfer. We abstract from the intricacies that have been explored in the health contracting literature, notably the multitasking aspects of the Principal-Agent relationship, and consider a simple framework in which the concern of the purchasing agency is to ensure treatment of an appropriate number of patients given uncertainty, at the time of the contract being written, regarding both the number of patients requiring treatment and the unit cost of treating them. We proxy for other physician agency concerns by allowing implementation costs (i.e. the costs of writing, negotiating and monitoring a contract) to vary across different forms of contract. Our approach is therefore to consider the determinants of the relative value to the purchaser of conditioning payment upon either the number of patients treated or cost (or both of these), against the benchmark of a fixed budget arrangement.

Empirical studies have examined the choice of contract in a variety of contexts: for reviews see Lyons (1996) and Chiappori and Salanié (1997, 2003). These include studies of agricultural sharecropping arrangements between farmers and tenants (e.g. Ackerberg and Botticini, 2002, and references therein); labour contracts (e.g. Lazear and Moore, 1984; Lazear, 2000); procurement (e.g. Crocker and Reynolds, 1993); contracts between coal mines and power stations (e.g. Joskow, 1985, 1987, 1988, 1990); and studies of franchising (e.g. Lafontaine, 1992), particularly between oil companies and gas stations (e.g. Shepard, 1993; Slade, 1996). Ackerberg and Botticini (2002), for example, find a relationship between the type of crop grown and the degree of fixed/share payment in sharecropping arrangements in Renaissance Tus-

cany. Crocker and Reynolds (1993) examine the completeness of contracts in air force procurement and find significant relationships with agent and service characteristics. Joskow (1990) finds evidence that contract duration is related to specific investments for mine-head power stations. Shepard (1993) finds the choice of contract form between oil companies and gas stations to be related to gas station characteristics. Corts and Singh (2004) find contract form for oil-drilling to be related to the characteristics of the project undertaken and the extent of interaction between the contracting parties. Thus, despite very different contexts, these studies all find theory-consistent relationships between the forms of contract adopted and the characteristics of the contracting environment. The present paper finds similar relationships in the context of health services.

The choice of contract form for health services is an area where a comparable empirical literature is still in the early stages of development. Despite various studies of the adoption by the US Medicare system of prospective payment, for example (e.g. DesHarnais et al, 1990; Freiman et al, 1989; Cohen and Spector, 1996; Ellis and McGuire, 1996; McClellan, 1997), it has not been possible to examine choice of contract by purchasers because in the Medicare system the form of payment is prescribed by law. As we have suggested, however, the NHS over the period 1990 to 1997 does allow such choice for local purchasers and so is a testing ground for the theory as it relates to contracting for health services. An earlier contribution in this vein is Csaba and Fenn (1997), who use data on the share of income that is fixed (i.e. not volume related) for 71 NHS providers from this period (1992-93) to show that the choice between fixed and volume related payment arrangements is consistent with a concern on the part of purchasers to secure local capacity when confronted by capacity constraints. Our paper builds on this earlier contribution in a number of ways. First, we directly observe contract types rather than infer them from the

proportion of provider income that is fixed. Second, because our contract data include information on purchasers, we are able to examine empirical relationships between observed purchaser characteristics and contract choice, and also to control for the effects of unobserved purchaser heterogeneity. Third, we observe the service type for each contract and therefore, unlike Csaba and Fenn (1997), we are able to test predictions about how the nature of the service being contracted for influences the form of contract. Fourth, our data sets are larger and taken from the two years either side of 1992-93. Despite these data differences, and despite a somewhat different conceptual framework, we find evidence consistent with some of Csaba and Fenn's (1997) earlier findings, e.g. that Trust status (see Section 2.1) can influence contract form.

The plan of this paper is as follows. In the following section we discuss the background to the health contracting reforms in the British NHS with a view to introducing terminology and describing our data. In Section 3, we present a simple model of choice of contractual form in the NHS. Section 4 describes our data in more detail, sets out the econometric model and summarises and discusses the empirical results. Section 5 concludes.

2 Contracts in the NHS 1990 - 1997

2.1 The Contracting Parties

After 1990 hospitals, which had previously been under the direct control of Health Authorities, could apply for NHS Trust status whereby they would be given discretion over employment, remuneration scales and the disposal of assets. This discretion was subject to limits and reservations and could ultimately be revoked if the appropriate authority, in this case the Secretary of State for Health, deemed their actions to be

against the 'public interest'. There has been much discussion regarding the objectives of these NHS Trusts, see for example Propper and Bartlett (1997), but a consensus view is that they are not-for-profit organisations. In addition, there are legislative requirements for them to balance revenue and cost (Barker et al, 1997). To capture these twin notions of provider benevolence and a strictly enforced budget constraint, in our theoretical framework we assume that NHS Trusts will take any revenue generated by a contract and, whenever possible, spend that revenue on treating their own patients. For some of the time period to which our data refers, some hospitals had not made the transition to full NHS Trust status. These hospitals were still at least partially under the direct control of their respective Health Authorities but nevertheless entered into contracts for the supply of services.

There were two types of purchasers of health services in the period that we investigate. Within our data, Health Authorities were the most prevalent purchasers. Whilst there are concerns that Health Authorities may have had objectives that did not strictly accord with those of government, for the purposes of our analysis we treat them as welfare maximising purchasers in the tradition of the theory of public purchasing of health care (Chalkley and Malcomson, 2000).

Compared with Health Authorities, GPs had a much smaller pool of individuals for whom they were required to purchase health services. Furthermore, GPs have knowledge of the precise medical conditions of their own patients and thus, relative to Health Authorities, contracted on behalf of a smaller and better known group of patients. GPs had to balance the benefits of the particular patients they expected to refer to a hospital with the welfare of their other patients and, hence, it is natural to consider that their purchasing decisions were motivated by overall patient welfare. It has been suggested that there were possibilities for GPs to benefit from any surplus of their budget allocation over expenditure, if not through increased income then

from increased expenditures on their businesses, and that it might, therefore, be appropriate to model GP purchasers as individual utility maximising economic actors. For the purposes of our simple theoretical framework we can allow for this possibility by implicitly allowing for GPs to place a lower weight on patient benefits.

2.2 The Contracts

In the first year following reform the most prevalent form of contract in the NHS simply specified a lump sum payment from purchaser to provider; these were termed *block* contracts. Under block contracts there was no link between the number of patients treated and the payment. A simple and obvious linkage is to pay a fixed amount for each patient treated; in the NHS these were termed *cost-per-case* contracts. A more complex, non-linear, relationship between the number of patients treated and contract value existed in what were termed *cost-and-volume*[2] *contracts.* Typically, in this kind of arrangement a fixed payment was agreed to cover a number of patients treated up to some limit, thereafter services being paid for at an agreed rate per case. We henceforth refer to cost-per-case and cost-and-volume contracts collectively as *volume-dependent-contracts.* Some contracts, which became known as *sophisticated block contracts* combined a lump sum payment with some alternative arrangements for determining payment should the number of patients treated, or the cost of treating them, fall outside of the expected or indicative range. Sophisticated block contracts did not typically precisely specify what payment would be made in the event that the indicative number of patients treated was not met, but explicitly allowed the possibility of *ex post* negotiation based upon the realised cost and (or) the number of patients treated[3]. These sophisticated block contracts became the most

[2]This term, which was used for these contracts in the NHS, is a misnomer — as an anonymous referee has pointed out, these contracts have no element of cost dependency.

[3]The distinction is subtle but one contract type (sophisticated block) explicitly allows for dependency on volume and cost (through renegotiation) and the other (simple block) does not. For

common contract form by the second round of contracting following the 1990 reforms.

2.3 The Services Being Contracted

Unlike the US Medicare system in which groups of patients with a specific medical condition – Diagnosis Related Groups (DRGs) – are subject to individual prices, contracts in the NHS during this period tended to cover broad categories of services. For most of the contracts we observe, there are four such broad categories: acute hospital services, non-acute hospital services, mental health services and community health services. Since uncertainty regarding demand will be one key consideration in our analysis, in Table 1 we report a measure of the variability of overall demand for the first three types of service in the NHS from 1960 to 1994.[4]

Table 1: Variability of NHS Services 1960 to 1994

Service	**Variability about trend growth**
Acute	0.11
Non-acute	0.07
Mental	0.04

Acute services included most of the medical and surgical procedures carried out in hospitals, including those delivered by accident and emergency departments. Most contracts covered a wide range of acute services. The precise mix of treatments (case-mix) that might be delivered under an acute contract could, therefore, be expected to

example, a typical sophisticated block contract contains the following statement regarding payment if volume is below the defined threshold:

> "Where projected activity appears unlikely to meet the minimum volume specified in (paragraph) 6.2 the Authority (DHA) will wish to re-negotiate the Contract Price on the basis of a marginal cost adjustment or agree with the Service Provider (hospital) what action is to be taken to achieve it"

[4]Growth rates are determined from data on total number of Finished Consultant Episodes (FCEs) in the NHS, 1960-1994 by running a regression $\ln(N_t) = \beta_0 + \beta_1 t + \epsilon$,where N_t is the number of FCEs and t is a time trend. Variability is given by the variance of the residuals of the above regression, which is a unit free measure of variation about trend growth.

vary considerably and as a consequence the cost per treated patient is also highly variable. Similarly, demand for acute services is more variable[5] than for other categories of service as indicated in Table 1.

Hospital non-acute services involved the treatment of chronic illness or disability and were largely accounted for by in-hospital care of elderly patients. In the UK as in the US (see Norton and Newhouse, 1994) there is perceived to be chronic excess demand and limited capacity for these types of hospital services.

Mental health services have a number of distinctive characteristics as a category of health care provision (see DesHarnais *et al.*, 1990) and particularly in the context of the NHS. There is relatively little variation in total delivery of these services over time (see Table 1) and they constitute a relatively small but tightly defined set of services. Compared to acute services, and perhaps non-acute services, we therefore expect the contracting parties to have anticipated less uncertainty regarding both demand and cost for mental health services.

Community services, which include health visiting and some geriatric at-home services, are unlike many hospital acute services in that they are likely to be supplied up to the capacity of the health care system rather than be constrained by demand. Therefore, as for hospital non-acute services, there is likely to have been less uncertainty regarding the quantity of such services that were to be delivered under a contract. This effect is likely to have been strengthened by the difficulty in measuring activity for community services; for hospital services the *Finished Consultant Episode* — essentially a count of the number of patients whose treatment is completed — was the standard measure of activity in the NHS, but no such comparable measure existed for community services[6]. As we will discuss below this has implications for the cost

[5]In part, some of the variation in demand is reflected in patients queuing for treatment through what are termed *waiting lists*.

[6]The problems associated with defining contracts for these services are set out in Flynn et al (1997).

of conditioning contractual payment upon the number of patients treated.

3 Contract Choice Framework

When the number of patients and the precise *costs* of treating them are unknown to the purchaser *ex ante,* a payment mechanism that makes no allowance for payment to be adjusted to reflect the overall cost of the patients actually requiring treatment risks either some patients going untreated, or payment in excess of that which is strictly necessary. Conditioning payment on numbers treated or allowing *ex post* re-determination of payment based on cost, however, necessitates costly monitoring. Furthermore with any reimbursement of treatment costs there is a risk of creating an incentive for actions on the part of the provider that will be detrimental to the purchaser. The following model is concerned with elucidating these ideas in a simple framework.

We suppose that our NHS purchaser is entering into a contract for a particular type of service as described in section 2 and is concerned with both the number of patients treated and the cost that it incurs in ensuring that treatment takes place. We denote the number of patients needing treatment by n and assume that each patient costs c to treat. Both c and n are random variables with respectively, distributions $f(n)$ and $g(c)$, which are known to both the purchaser and hospital at the time the contract is drawn up. The hospital observes realizations of n and c prior to deciding what treatments it will carry out, but after it has entered into a contract with the purchaser.

We assume that our purchaser, being concerned with the welfare of patients derives (increasing and concave) benefit of $b(n^h)$ from n^h patients receiving treatment at the hospital and must choose a contract which pays the hospital either a lump sum, or according to either, or both of, the realised number of patients treated and the

realised costs of treating each patient. We write this contract in the form of a payment function $P(n^h, c)$. The form of contract specified by the purchaser will, together with the realisations of c and n, influence the hospital's decision regarding how many patients to treat. We denote this choice $n^h(n, c, P)$.

To capture the idea that contracts which are conditioned upon more information require effort in terms of monitoring and, further, to capture the notion prevalent in the literature that a contract that *ex post* reimburses the actual cost incurred weakens incentives for cost control, we allow for an additional cost of enforcing the contract of $\kappa \in \{\kappa_0, \kappa_n, \kappa_c\}$ where κ_0 relates to a contract in which neither c nor n^h are used to condition payment, κ_n relates to a contract where payment is conditioned on n^h, and κ_c relates to a contract where payment is conditioned on c. We assume that $\kappa_0 < \kappa_n < \kappa_c$, capturing the idea that any additional monitoring of the provider is costly and that treatment costs are more difficult to monitor than the number of patients treated[7]. Whilst we do not have direct observations of monitoring costs, there are a number of purchaser and provider characteristics which are plausibly correlated with these and which will be discussed in Section 3.2.

The hospital, as noted above, incurs the cost c for each patient treated but is also itself concerned with the well-being of its own patients and derives a benefit which for simplicity we assume to be H for each patient treated. The fixed nature of this benefit, and the fact that it does not mirror the purchaser's benefit $b(.)$ constitute the physician agency problem within our framework. For the reasons indicated in section 2 above, we assume that the hospital does not derive any benefit from a financial surplus that it can obtain under its contract but is simply concerned with the number of patients it treats and the benefits they enjoy, given its budget constraint. We thus assume that the hospital is *benevolent* in the sense used by Chalkley and Malcomson

[7]In particular if conditioning payment on cost reduces incentives to control cost, it may be necessary to verify the claims of the provider about the sources of any cost over-run, as well as verifying the actual extent of the over-run.

(1998). We assume further that the hospital can at most treat N patients on account of a capacity constraint. Hence, given $P(.)$ the hospital having observed n and c will choose n^h to maximise Hn^h subject to $P(n^h, c) \geq n^h c$ and $n^h \leq \min\{n, N\}$.

Formally the purchaser's problem is one of selecting a form for $P(.)$ to maximise

$$W(C) = E_{c,n}[b(n^h(n, c, P)) - P(n^h(n, c, P), c) - \kappa] \tag{1}$$

The best that the purchaser can achieve is a contract, with minimal monitoring costs, that ensures for each possible joint realisation of n and c that the hospital chooses n^h to satisfy either $b'(n^h) = c$, or (if $b'(N) > c$) $n^h = N$. We denote this first best treatment number by n^*. In practice the purchaser will have to accept some deviation from n^* if it is to economise on monitoring. It is the trade-off between ensuring efficient treatment and containing monitoring costs that we view as determining contract choice.

There are three forms of payment mechanism that are closely analogous to the contracts that we observe in the post 1990 NHS. A simple *block* contract specifies a payment of B which is paid to the hospital independently of the observed realisations of n^h or c. Under this arrangement, and given our assumptions, the hospital will choose to treat all patients who arrive to be treated up to the point where its fixed budget B is exhausted. Thus the number treated under a block contract satisfies $n^B(n, c, B) = \min\{n, B/c, N\}$ and the purchaser's expected welfare from the block contract is $W^B(B) = E_{c,n}[b(n^B) - B - \kappa_0]$. Denoting by B^* the fixed payment that maximises this expected welfare, the best the purchaser can achieve using a block contract is a welfare of $W^{*B} \equiv W^B(B^*)$.

To capture the essence of volume-dependent-contracts, we focus here on the cost-per-case arrangement, being the simpler payment scheme. With a cost-per-case contract the purchaser specifies a price per patient treated of p. With this arrangement,

the hospital will treat all the patients it receives, up to its capacity, provided that $p \geq c$, so that the number treated satisfies

$$\begin{aligned} n^c(n,c,p) &= \min\{n, N\} \text{ if } p \geq c \\ &= 0 \text{ otherwise.} \end{aligned}$$

The purchaser's welfare from a cost-per-case contract is thus $W^c(p) = E_{c,n}[b(n^c) - pn^c - \kappa_n]$ and again, denoting by p^* the fixed price per patient that maximises this expression, the best the purchaser can achieve using a cost-per-case contract is a welfare of $W^{*c} \equiv W^c(p^*)$.

Finally, to capture the essential characteristic of a *sophisticated block* contract, which facilitates an *ex post* re-negotiation based upon realised cost, we suppose that payment under this arrangement ensures that all patients (up to N) are treated by setting payment $B^s = n^s c$, where $n^s(n,c) = n^*$. In this case the purchaser's welfare is $W^{*s} = E_{c,n}[b(n^s) - cn^s - \kappa_c]$. With this characterisation of the sophisticated block contract, the purchaser can always ensure *ex post* first best treatment numbers but must incur the monitoring cost κ_c in order to do so.

We suppose that the purchaser will choose its contract rationally so that the contract chosen will reflect the maximum of W^{*B}, W^{*c} and W^{*s}. Under what circumstances will the different forms of contract be chosen? This depends on the type of service being contracted for and the characteristics of purchasers and providers.

3.1 Different service types

Consider first a type of health service for which the variations in both cost and numbers treated are small. The overall cost of provision is thus predictable and a contract

that simply pays a fixed sum to the hospital will incur a negligible loss on account of patients going untreated. Such an arrangement requires no monitoring of the hospital and is thus likely to be preferable. In the absence of any variability in both n and c it is, therefore, clear that $W^{*B} > W^{*c} > W^{*s}$. Even when there is *ex ante* uncertainty regarding the number of patients who will require treatment but there is reasonable certainty that this number will exceed N, and the purchaser wishes at least N patients to be treated, a fixed budget of cN will achieve the purchaser's requirements at minimal cost in terms of monitoring. We therefore have an empirically testable conjecture:

Conjecture 1 *Health services for which* either *variation in both cost and numbers treated are small* or *variation in cost is small and that are supplied up to a known capacity of the health care system, will give rise to a greater use of block contracts, relative to cost or volume dependent alternatives.*

Relating this discussion to the categories of services described in Section 2, then in terms of the existence of binding capacity constraints, both community health services and, to a lesser degree, non-acute hospital services and mental health services are noted to be capacity constrained. In relation to variability of demand, mental health services, on the limited evidence we have, come closest to the requirement of certain demand.

Turning next to health services for which the capacity constraint is unlikely to bind and for which variations in cost are small but variations in numbers requiring to be treated are significant, it is clear that the cost-per-case arrangement, which varies payment directly with the number of patients treated and which requires only monitoring of treatment numbers, is a natural choice. Under this arrangement the purchaser can achieve ex post first best treatment numbers, and only if $\kappa_n - \kappa_0$ is large will the purchaser wish to forgo this in order to save on monitoring costs. Provided,

therefore, that there is a sufficiently large loss to the purchaser of patients being untreated, then $W^{*c} > W^{*B}$, because under a block contract, once the provider's budget is exhausted patients will be left untreated. Furthermore, if there is no variability in cost, $W^{*c} > W^{*s}$ simply on account of $\kappa_n < \kappa_c$, because under both arrangements the purchaser can ensure that all patients who actually arrive to be treated are in fact treated. Hence, under these conditions a cost-per-case contract is likely to be chosen.

Conjecture 2 *Provided that the costs of monitoring treatment numbers are not excessive, health services for which there is a significant variation in demand and small variation in costs, will give rise to a greater use of volume-dependent-contracts such as cost-per-case payments in preference to block contracts.*

Potentially any of the broad categories of health services we have described in Section 2 could conform to the requirements of Conjecture 2 except perhaps community health services where, as we have noted the costs of monitoring the number of patients treated may be prohibitive given the difficulty of defining the nature of treatment.

This leaves the kind of ex post arrangement requiring monitoring of costs – implied by sophisticated block contracts – to be the most likely contract of choice when there is substantial variation in costs, particularly where there is also variation in the number requiring treatment and where the capacity constraint is unlikely to be binding. Hence, for completeness we propose,

Conjecture 3 *Health services for which there is considerable variation in costs of treatment, particularly where there is also variation in demand for treatment, will give rise to a greater use of sophisticated block contracts relative to either simple block or solely volume dependent contracts.*

Of the services we describe in Section 2, acute hospital services appear a natural candidate for higher than average cost and demand variability.

3.2 Purchaser and provider characteristics and monitoring costs

It follows directly from the framework set out in Section 3 that higher monitoring costs favour the use of simpler contracts – the simplest form of contract we observe being block contracts and the most complex being sophisticated block contracts. Hence,

Conjecture 4 *Characteristics of purchasers and / or providers that mitigate monitoring costs will give rise to a greater use of volume-dependent and sophisticated block contracts relative to simple block contracts.*

As noted in Section 2 some purchasers of services were GPs who have a number of distinguishing characteristics as purchasers. First, GPs have detailed information on their own patients so that for them there is likely to be less *ex ante* uncertainty regarding both the number of patients who will require hospital services and perhaps less uncertainty regarding the cost of treating those patients. Relating this to the discussion in Section 3.1 suggests that for these purchasers it is more likely that a block contract will yield the highest welfare. However, an offsetting tendency exists if the more intimate knowledge of their patients that GPs possess acts to mitigate monitoring costs – then according to Conjecture 4 either the cost-per-case or sophisticated block contract will yield higher welfare. The impact of the purchaser being a GP would, therefore, appear ambiguous.

The proximity, both physical and in terms of management structure, of purchaser and provider can be expected to have a mitigating impact on monitoring costs. It should be noted that in some cases the hospital provider was previously directly managed by the Health Authority purchaser with which it contracted. For these contracts the purchaser could use its knowledge of the information systems and management practices of the hospital concerned to reduce the monitoring costs. In terms of man-

agement arrangements, hospitals that had not yet attained NHS trust status at the time of a contract might be expected to be closer to Health Authority in terms of management structure.

Note, there is no role within our framework for the extent of competition between providers or purchasers to affect the form of contract chosen. From the perspective of theory, the extent of competition will affect the total amount that the purchaser may need to pay in order to satisfy the provider's participation constraint and hence will affect the levels of W^{*B}, W^{*c} and W^{*s} but will not affect the ranking of these.

Conjecture 5 *The extent of purchaser or provider competition will not influence the adoption of block, volume-dependent or sophisticated block contracts.*

4 Empirical Implementation

4.1 Data

We use two sources of data. The first is physical copies of 236 contracts drawn from the 1991/92 round of contracting, across 52 purchasers. These data derive from either computer scanned copies of contracts as retained by the National Association of Health Authorities and Trusts (NAHAT) or from hard copies of actual contracts obtained from NAHAT. Our second data set comes from a telephone survey of Health Authorities from which we derive information on 464 contracts from the 1993/94 round of contract negotiations, across 106 purchasers. Both data sets contain similar (though not identical) information on contractual form and service type. There are also additional data on purchaser and provider characteristics that are specific to each data set.

4.1.1 Data Set 1

For each contract in the first data set we extract information on a number of characteristics guided by the model of the previous section. First, the form of the contract can be categorised into one of four types: block (henceforth, BC, 22%), sophisticated block (henceforth, SBC, 68%), cost-and-volume and cost-per-case (henceforth, collectively[8], VDC, 10%). Since contracts (at this early stage following the reforms) did not necessarily all specify their form according to this categorisation, we categorised them by examining their exact terms. Second, we observe the type of services that were being contracted for, and these are categorised into one of four groups as described in Section 2.3 : HOSPITAL ACUTE, HOSPITAL NONACUTE, MENTAL HEALTH and COMMUNITY health services. We denote contracts that cover more than one of the above service types as MULTIPLE. Third, we observe the name and type of purchaser (Health Authority or GP) which allows us to construct a GP dummy as well as a unique purchaser identifier. Fourth, we observe whether the provider was in the same district (within the Health Authority area) as the purchaser — giving rise to DISTANT PROVIDER — and whether it had NHS TRUST status.[9] Finally, we have information on purchaser and provider density which we use as proxies of market structure — giving rise to our PROVIDER CONCENTRATION and PURCHASER CONCENTRATION variables.

[8] We observe only 8 cost-per-case and 17 cost-and-volume contracts from this cross-section and therefore aggregate - since both contract forms essentially share the same property of volume dependence - into a singe VDC category.

[9] At this early stage following the reforms, few hospitals had yet been granted Trust status and few GPs had yet been granted Fundholder status (see Table 3).

4.1.2 Data Set 2

In the second data set we also have information on the form of contract but in this case as reported by the purchaser.[10] Hence, in this data set there are three reported contract forms: BC (23%), SBC (61%) and cost-and-volume, which we term VDC (16%). By the date of the telephone survey the term sophisticated block contract was in common usage and although we could not go back and check whether the same criteria were used in defining these contracts as we had used for the first data set, other information on these contracts is consistent with their categorisation.

The type of services contracted for in the second data set are categorised only as either HOSPITAL ACUTE, or COMMUNITY or MENTAL HEALTH services. As for data set 1 we know whether the provider was in the same district as the purchaser so we can again specify a DISTANT PROVIDER dummy. An additional piece of information for each contract in the second data set is whether clinicians were present in the contract negotiations giving rise to our variable CLINICIAN PRESENT. All purchasers in the second data set are Health Authorities for which we can again specify a unique identifier. Table 3 lists the observed variables and summary statistics are reported in Table 4.

4.2 A Mixed Multinomial Logit Model of Contract Choice

We consider the choice of contract form as being a consequence of the type of service, purchaser/provider characteristics and a random error term. The natural specification for such a multiple unordered choice problem is the multinomial logit (MNL) model, e.g. as adopted by Shepard (1993) in the context of gas station franchising. The purchasers in our data sets, whether Health Authorities or GPs can be expected

[10] There are no GP Fundholder contracts in the second data set - all purchasers are Health Authorities.

to have many unobserved characteristics. In the context of our model these could correspond to purchasers having different precise forms for $b(n^h)$ or different weights for κ. Ignoring such unobserved heterogeneity leads to biased parameter estimates in the MNL model (see e.g. Arrelano and Honoré, 2001). Given that we observe multiple contracts for purchasers in both data sets, we can to some extent control for such unobserved heterogeneity. We therefore consider a Mixed MNL model by allowing for random, purchaser-specific intercepts.(see Greene, 2003, pp728-9). [11]

We index decision makers (health authorities or GP fundholders) by $i \in \{1, 2, 3, ..., I\}$ and note that we have a number of instances of contract choice by each decision maker, that we index by $t \in \{1, 2, 3, ...T\}$. As described above there are three outcomes of choice, these are our 3 contract types, that we index by $j \in \{1, 2, 3\}$. The probability that purchaser i selects contract of type j on the t'th instance can be written as

$$P_{ijt}(\beta_i) = \frac{e^{\beta_i' x_{ijt}}}{\sum_{k=1}^{3} e^{\beta_i' x_{ikt}}}.$$

where, given that we have k observed variables (including the constant) relating to the characteristics of each contract, x_{ijt} is a $1 \times 3k$ vector of observed characteristics and β_i is a $1 \times 3k$ vector of parameters. If we allow for each parameter in this vector to drawn from a distribution with p parameters (termed the 'deep' parameters in the literature to distinguish them from the conventional regression parameters) then we would to need estimate a total of $3k(1 + p)$ regression parameters.

Instead we consider 2 special cases of the general Mixed MNL model. In the first we assume $\beta_i = \beta$ for all i which yields the standard MNL model. In the second case we assume that only the elements of β_i corresponding to the contract type-specific

[11] Fixed effects specifications in discrete outcome settings are rarely used due to the problem of incidental parameters - the fixed effects cannot be 'differenced out' - leading to proliferation of parameters and inconsistency of parameter estimates (see Arrelano and Honoré, 2001) .

constants vary and thus consider what we term a Random Intercept MNL. Data limitations preclude the estimation of more general Mixed MNLs

We might also expect unobserved heterogeneity among providers, e.g. provider reputation, where a 'good' reputation might reduce monitoring costs over and above what we capture with our distant provider variables. However, because of the likely weighting of purchaser and provider preferences in the choice of contract, and because we observe only single contracts for many providers, we do not take account of unobserved provider heterogeneity in our extended model.

4.3 Regression Results

The standard MNL model (without random effects) is our starting point, and is estimated separately on each data set by maximum likelihood. In both data sets MENTAL HEALTH is the omitted service type variable. Pooling of contract types (e.g. pooling BC and SBC) is rejected for all possible pair-wise combinations, across both data sets, according to Cramer-Ridder tests (see Cramer and Ridder, 1991) and so the MNL specification is supported over binary alternatives. The Hausman tests fail to reject Independence of Irrelevant Alternatives (IIA) in all cases, again across both data sets, providing further support for the MNL specification (see Hausman and McFadden, 1984). MNL regression coefficients need to be interpreted with care since they indicate the responsiveness of log-odds ratios and *not* probabilities. However, our empirical conjectures - which are couched in relative terms - are most easily interpreted in terms of these log-odds ratios. We therefore discuss regression coefficients in preference to marginal effects but include the latter for completeness. Table 5 summarises the regression coefficients for the first data set and Table 6 those for the second data set: marginal effects[12] are reported in Tables 7 and 8 respectively.

[12]The marginal effects for both models were computed using a Monte Carlo simulation. For each model 10,000 draws from the distributions of parameters were made, and for each draw the

In these, and all subsequent, tables an * denotes significant at the 95% level.

We then estimate the mixed MNL model allowing for purchaser-specific intercepts, again separately on each data set, by maximum simulated likelihood[13] . Regression coefficients for this extended model are reported[14] in Tables 9 and 10: marginal effects are reported in Tables 11 and 12 respectively. The mixed MNL estimates suggest the presence of significant unobserved purchaser heterogeneity in both data sets, and log-likelihoods are considerably higher for the mixed MNL models compared to the standard MNL models so that conventional Likelihood Ratio tests would favour the mixed MNL models. Although the parameter estimates from the standard MNL and mixed MNL models are qualitatively similar - e.g. in terms of statistical significance and signs - in most respects, there are quantitative differences, and some qualitative differences, which may indicate bias in the standard MNL model. The following discussion, therefore, concentrates on the mixed MNL estimates, although most of the conclusions also hold for the standard MNL estimates. For convenience in Table 2 we summarise the statistically significant (95%) effects of variables, across both data sets, on the relative likelihood of different contract types.

Our framework suggests (Conjectures 2 and 3) that contracts for acute services are more likely to entail volume dependency and cost dependency than contracts for mental health services. In both data sets, this is confirmed by the regression results – the log-odds ratios of both SBC and VDC, relative to BC, are significantly increased by ACUTE HOSPITAL. In data set 1, and consistent with Conjecture

marginal effect was computed. The reported standard errors are the standard deviations of the resulting distributions for the marginal effects.

[13]We used NLOGIT and, as a check for robustness, the GLLAMM package for Stata (see Rabe-Hesketh *et al*, 2004). Random effects are assumed to be distributed according to the binomial distribution. Results are robust to alternative specifications, e.g. normally distributed random effects.

[14]We report the mean of the purchaser specific random intercepts for (PURCHASER INTERCEPTS 1 and 2) and the associated estimated variance of these terms. Variance statistically different from zero indicates that we cannot reject the hypothesis of purchaser specific heterogeneity.

Table 2: Summary of the effects of variables on the relative likelihood of different forms of contract

Variable	Likelihood of SBC relative to BC	Likelihood of VDC relative to BC	Likelihood of VDC relative to SBC
HOSPITAL ACUTE	+	+	
HOSPITAL NONACUTE			–
COMMUNITY		–	–
MULTIPLE SERVICES	+	+	
GP	–		
NHS TRUST	–	–	
PURCHASER CONC.			
PROVIDER CONC.			
DISTANT PROVIDER	+	+	
CLINICIAN PRESENT DISTANT PROVIDER	+		–

3, HOSPITAL NONACUTE increases the log odds-ratio of SBC relative to BC: this effect is significant for the MNL model and maintains the same sign but is not significant in the mixed MNL estimates. In the context of our model, this could reflect greater uncertainty over the cost per treatment or lower monitoring costs for these services relative to MENTAL HEALTH services.

According to Conjecture 1 contracts for COMMUNITY SERVICES should be less likely to use VDC and SBC than contracts for MENTAL HEALTH services. Again, the regression results generally support this: In both data sets the log-odds ratios of VDC relative to BC are lower for COMMUNITY SERVICES contracts and this effect is significant for data set 2. In the first data set, but not the second, there is also a marginally significant negative impact on the log odds ratio of SBC relative to BC.

MULTIPLE SERVICES (only found in data set 1) significantly increases the log-odds ratios of both SBC or VDC relative to BC. Again, these effects are consistent with Conjectures 2 and 3 reflecting a desire for greater volume dependency and cost

dependency where numbers treated and cost per case are uncertain ex ante. This shift away from BC suggests (as we might expect given their relative weights in overall Health Authority expenditure) that acute services may outweigh other services in these broad service contracts.

Our model suggests (Conjecture 4) that a provider that is in some way (either physically or in terms of motivation) distant from the purchaser will be more likely to be contracted with BC than SBC or VDC because of higher monitoring costs. Our two variables here are NHS TRUST and DISTANT PROVIDER, both of which we might expect to have similar signed effects, but this is not borne out unambiguously in the regression estimates. In data set 1, whilst it is true that NHS TRUST (marginally) significantly reduces the log-odds ratio of SBC to BC, the opposite is the case for DISTANT PROVIDER, which increases the likelihood of SBC or VDC relative to BC. Interpreted in the context of our model this suggests that DISTANT PROVIDER may not be a good proxy for monitoring costs. One possible explanation is that contracts with physically distant providers in data set 1 may be for different, perhaps more specialised, health services that are not available within the local Health Authority area, for example the services of severe burns units. DISTANT PROVIDER may therefore act as a proxy for these types of services, and this effect (uncertainty regarding c and n), over and above that of the general acute services variable, is outweighing any monitoring costs effects. Further detailed breakdown of service types might help us explore this question further, but additional data are required for this. In data set 2, DISTANT PROVIDER takes the predicted negative sign for both log odds comparisons, but is statistically insignificant. Note that the nature of the telephone survey on which data set 2 is based - focusing on larger contracts for each of the three service types - means that small contracts for specialised services are unlikely to be included in the sample.

Our prediction for the effect of a purchaser being a GP with respect to contract form is ambiguous. Two competing Conjectures (1 and 4) are suggested by our framework – lower monitoring costs, leading to an increased use of SBC and more certainty regarding c and n giving rise to an increased use of BC. The regression results are consistent with the view that certainty regarding c and n is the dominant effect: the log-odds ratio of SBC relative to BC is significantly reduced by GP, and GP takes a negative sign, but is not statistically significant, for the log-odds ratio of VDC relative to BC.

CLINICIAN PRESENT in contract negotiations increases the log-odds ratio of SBC to BC (borderline significant) and significantly reduces the log-odds ratio of VDC to SBC. Interpreted in the context of our framework this suggests that the presence of clinicians is associated with a lower κ_c.

Finally our measures of purchaser and provider concentration, included as additional controls in data set 1 were predicted (Conjecture 5) not to have an influence on contract form. The coefficients for these variables, which are admittedly imperfect proxies for competition, appear consistent with this prediction: neither significantly influences any of the log-odds ratios. Fenn et al. (1994) and Csaba and Fenn (1997) suggest that purchaser competition — in a capacity constrained health care system — might lead purchasers to set contracts that secure a number of beds at local hospitals ex ante. The lack of evidence for such behaviour here – using data from one year earlier than Csaba and Fenn (1997) – may reflect the poor quality of our concentration measures but is also consistent with purchasers learning the need for supply assurance only slowly over time.

5 Discussion

At the time contracts were initiated in the NHS there was considerable scepticism as to the degree of sophistication which purchasers and providers would bring to the contract negotiations. However, the view that contracts are chosen arbitrarily, or entirely at the whim of individual purchasers, is rejected by the data we have considered. Instead, the results discussed above exhibit statistically significant effects, across two independent data sets, that are consistent with our simple agency framework of choice of contractual form in the NHS. Specifically, we show that the nature of the services being contracted for, purchaser characteristics and provider characteristics all have significant effects on the forms of contract chosen.

The present study thus supports the view that contractual form is systematically related to exogenous factors consistent with the predictions of contract theory and does so in a context where the motivation of economic decision makers is largely seen as not-for-profit (Newhouse, 1970). In also showing how the nature of the health services being contracted for is related to contractual form, we extend the existing evidence in support of contract theory. Furthermore, the data that we have considered were generated in the immediate aftermath of the adoption of a contractual system and thus our analysis finds evidence to support the view that even a newly established contractual system results in rational choice of contract form.

The findings of this research have a number of implications for health care policy. In both the British NHS and many other health care systems, including US Medicare, there has been a movement away from payment systems that reimburse health care providers according to the cost of the services they deliver. The motivation for that movement is based upon the perceived incentive benefits of payment systems that ensure that providers of service are residual claimants over any cost savings they achieve. For example the current English NHS under a system termed *Payment by*

Results prescribes contracts that specify a fixed price per treatment, i.e. cost per case. Contract theory, however, provides a number of justifications for incorporating an element of cost reimbursement into an optimal payment system and we have found that purchasers in the British NHS, when given a choice, were willing to allow ex post adjustment of payment to reflect cost in circumstances consistent with those theoretical justifications. This suggests a tension between the intentions of policy makers and the incentives of purchasing agencies. Recently, Audit Commission (2005, paragraph 149) has found evidence of such tensions in the arrangements between purchasers and providers, which in some cases continue to contain elements of cost dependency.

References

Ackerberg, D. A. & Botticini, M. (2002), 'Endogenous matching and the empirical determinants of contract form', *Journal of Political Economy* **110**(3), 564–591.

Allen, R. & Gertler, P. (1991), 'Regulation and the provision of quality to heterogenous consumers: The case of prospective pricing of medical services', *Journal of Regulatory Economics* **3**, 361–375.

Arrelano, M. & Honoré, B. (2001), Panel data models: some recent developments, *in* J.J. Heckman & E. Leamer, eds, 'Handbook of Econometrics Volume 5', Elsevier, Amsterdam.

Audit Commission (2005), 'Early lessons from payment by results', *Audit Commission National Report*

Audit Commission (2006), 'Payment by results assurance framework', *Audit Commission National Report*

Barker, K., Chalkley, M., Malcomson, J. M. & Montgomery, J. (1997), Contracting in the National Health Service: Legal and economic issues, *in* R. Flynn & G. Williams, eds, 'Contracting for Health: Quasi-Markets and the National Health Service', Oxford University Press, Oxford, pp. 82–97.

Chalkley, M. & Malcomson, J. M. (1998*a*), 'Contracting for health services when patient demand does not reflect quality', *Journal of Health Economics* **17**(1), 1–19.

Chalkley, M. & Malcomson, J. M. (1998*b*), 'Contracting for health services with unmonitored quality', *Economic Journal* **108**(449), 1093–1110.

Chalkley, M. & Malcomson, J. M. (2000), Government purchasing of health services, *in* A. J. Culyer & J. P. Newhouse, eds, 'Handbook of Health Economics', North-Holland, Amsterdam.

Chalkley, M. & Malcomson, J. M. (2002), 'Cost sharing in health service provision: An empirical assessment of cost savings', *Journal of Public Economics* **84**(2), 219–249.

Chiappori, P.-A. & Salanié, B. (1997), 'Empirical contract theory: The case of insurance data', *European Economic Review* **41**, 943–950.

Chiappori, P.-A. & Salanié, B. (2003), 'Testing contract theory: a survey of recent work', *in* M. Dewatripont, L. Hansen & S. Turnovsky, eds, 'Advances in Economics and Econometrics', Cambridge University Press, Cambridge.

Cohen, J. W. & Spector, W. D. (1996), 'The effect of Medicaid reimbursement on quality of care in nursing homes', *Journal of Health Economics* **15**, 23–48.

Corts, K. S. & Singh, J. (2004), 'The effect of repeated interaction on contract choice: evidence from offshore drilling', *Journal of Law, Economics and Organization* **20**, 230-260

Crocker, K. J. & Reynolds, K. J. (1993), 'The efficiency of incomplete contracts: An empirical analysis of air force engine procurement', *RAND Journal of Economics* **24**(1), 126–146.

Csaba, I. & Fenn, P. (1997), 'Contractual choice in the managed health care market. An empirical analysis', *Journal of Health Economics* **16**(5), 579–588.

DesHarnais, S. I., Wroblewski, R. & Schumacher, D. (1990), 'How the Medicare prospective payment system affects psychiatric patients treated in short-term general hospitals', *Inquiry* **27**, 382–388.

Dixon, R. (2004), 'Payment by results – new financial flows in the NHS', *British Medical Journal* **328**, 969–970.

Ellis, R. P. & McGuire, T. G. (1990), 'Optimal payment systems for health services', *Journal of Health Economics* **9**(4), 375–396.

Ellis, R. P. & McGuire, T. G. (1996), 'Hospital response to prospective payment: Moral hazard, selection, and practice-style effects', *Journal of Health Economics* **15**(3), 257–277.

Fenn, P., Rickman, N. & McGuire, A. (1994), 'Contracts and supply assurance in the UK health care market', *Journal of Health Economics* **13**, 125–144.

Flynn, R., Williams, G. & Pickard, S. (1997), Quasi-markets and quasi-trust: The social construction of contracts for community health services, *in* R. Flynn & G. Williams, eds, 'Contracting for Health: Quasi-Markets and the National Health Service', Oxford University Press, Oxford, U.K., pp. 47–64.

Freiman, M. P., Ellis, R. P. & McGuire, T. G. (1989), 'Provider response to Medicare's PPS: Reductions in length of stay for psychiatric patients treated in scatter beds', *Inquiry* **26**, 192–201.

Glazer, J. & McGuire, T. G. (1994), 'Payer competition and cost shifting in health care', *Journal of Economics and Management Strategy* **3**(1), 71–92.

Greene, W. H. (2003), 'Econometric Analysis 5th Edition', Prentice Hall, New Jersey.

Joskow, P. L. (1985), 'Vertical integration and long-term contracts: The case of coal-burning electric generating plants', *Journal of Law, Economics and Organization* **1**(1), 33–80.

Joskow, P. L. (1987), 'Contract duration and relationship-specific investments: Empirical evidence from coal markets', *American Economic Review* **77**(1), 168–185.

Joskow, P. L. (1988), 'Price adjustment in long-term contracts: The case of coal', *Journal of Law and Economics* **31**, 47–83.

Joskow, P. L. (1990), 'The performance of long-term contracts: Further evidence from coal markets', *RAND Journal of Economics* **21**(2), 251–274.

Lafontaine, F. (1992), 'Agency theory and franchising: Some empirical results', *Rand Journal of Economics* **23**(2), 263–283.

Langenbrunner, M., Orosz, E., Kutzin, J. & Wiley, M. (2005), Purchasing and paying providers, *in* J. Figueras, R. Robinson & J. Jacubowski, eds, 'Purchasing to improve health systems performance', The European Observatory on Health Systems and Policies, Open University Press, Maidenhead.

Lazear, E. P. (2000), 'Performance pay and productivity', *American Economic Review* **90**(5), 1346–1361.

Lazear, E. P. & Moore, R. L. (1984), 'Incentives, productivity, and labor contracts', *Quarterly Journal of Economics* **99**, 275–296.

Lyons, B. (1996), 'Empirical relevance of efficient contract theory: Inter-firm contracts', *Oxford Review of Economic Policy* **12**(4), 27–52.

Ma, C.-t. A. (1994), 'Health care payment systems: Cost and quality incentives', *Journal of Economics and Management Strategy* **3**(1), 93–112.

McClellan, M. (1997), 'Hospital reimbursement incentives: An empirical analysis', *Journal of Economics and Management Strategy* **6**(1), 91–128.

Newhouse, J. P. (1970), 'Toward a theory of nonprofit institutions: An economic model of a hospital', *American Economic Review* **60**(1), 64–74.

Norton, E. C. (2000), Long-term care, *in* A. J. Culyer & J. P. Newhouse, eds, 'Handbook of Health Economics', North-Holland, Amsterdam.

Norton, E. C. & Newhouse, J. P. (1994), 'Policy options for public long-term care insurance', *Journal of the American Medical Association* **271**(19), 1520–1524.

Pope, G. C. (1989), 'Hospital nonprice competition and Medicare reimbursement policy', *Journal of Health Economics* **8**(2), 147–172.

Propper, C. & Bartlett, W. (1997), The impact of competition on the behaviour of National Health Service trusts, *in* R. Flynn & G. Williams, eds, 'Contracting for Health: Quasi-Markets and the National Health Service', Oxford University Press, Oxford, pp. 14–29.

Rabe-Hesketh, S., Skrondal, A. & Pickles, A. (2004), GLLAMM Manual. *U.C. Berkeley Division of Biostatistics Working Paper Series* Working Paper 160.

Robinson, R. & Le Grand, J., eds (1993), *Evaluating the NHS Reforms*, King's Fund Institute.

Rogerson, W. P. (1994), 'Choice of treatment intensities by a nonprofit hospital under prospective pricing', *Journal of Economics and Management Strategy* **3**(1), 7–51.

Shepard, A. (1993), 'Contractual form, retail price and asset characteristics in gasoline retailing', *Rand Journal of Economics* **24**(1), 58–77.

Slade, M. (1996), 'Multitask agency and contract choice: An empirical explanation', *International Economic Review* **37**(2), 465–486.

Table 3: Variable Definitions

Variable	Description
	Service Types
HOSPITAL ACUTE	1 if the contract is for acute services
HOSPITAL NONACUTE	1 if the contract is for hospital non-acute services
MENTAL HEALTH	1 if the contract is for mental health services
COMMUNITY	1 if the contract is for community services
MULTIPLE	1 if the contract is for more than one service type
	Provider/Purchaser Characteristics
NHS TRUST	if the contract is with an NHS Trust hospital
DISTANT PROVIDER	if the provider is outside the Health Authority's boundary
GP	1 if the purchaser is a GP
PURCHASER CONCENTRATION	Number of GP Fundholders per 100,000 population
PROVIDER CONCENTRATION	Number of providers of similar services within 10 miles
	Characteristics of negotiations
CLINICIAN PRESENT	1 if clinicians present in the contract negotiations

Table 4: Descriptive Statistics

Variable	Sample Mean (Std. Dev.)	
	Data Set 1	Data Set 2
HOSPITAL ACUTE	0.20	0.33
HOSPITAL NONACUTE	0.23	n/a
MENTAL HEALTH	0.22	0.35
COMMUNITY	0.20	0.32
MULTIPLE	0.15	n/a
NHS TRUST	0.04	n/a
DISTANT PROVIDER	0.16	0.14
GP	0.07	n/a
PURCHASER CONCENTRATION	0.51 (0.52)	n/a
PROVIDER CONCENTRATION	2.01 (5.33)	n/a
CLINICIAN PRESENT	n/a	0.57
NUMBER OF OBSERVATIONS	236	464

Table 5: Coefficent Estimates, MNL Data Set 1

	SBC relative to BC	**VDC relative to BC**	**VDC relative to SBC**
Variable	coefficient (std. error)	coefficient (std. error)	coefficient (std. error)
HOSPITAL ACUTE	.917 (.617)	2.120 (.830)*	1.204 (.669)
HOSPITAL NONACUTE	1.854 (.732)*	1.478 (1.035)	-.376 (.823)
COMMUNITY	-.714 (.477)	-2.020 (1.200)	-1.306 (1.167)
MULTIPLE SERVICES	1.668 (.791)*	1.834 (1.042)	.166 (.787)
GP	-3.407 (1.068)*	-2.328 (1.398)	1.079 (1.117)
NHS TRUST	-1.811 (.841)*	-1.426 (1.372)	.385 (1.268)
PURCHASER CONC.	-.080 (.457)	-0.727 (.645)	-0.647 (.545)
PROVIDER CONC.	.252 (.155)	-.007 (.226)	-.259 (.178)
DISTANT PROVIDER	2.627 (.937)*	3.340 (1.084)*	.713 (.644)
constant	.595 (.518)	-1.102 (.794)	-1.671 (.690)*
No. of observations		236	
Log likelihood		-153.72	
Pseudo R^2		.210	

Table 6: Coefficient Estimates MNL Data Set 2

	SBC relative to BC	**VDC relative to BC**	**VDC relative to SBC**
Variable	coefficient (std. error)	coefficient (std. error)	coefficient (std. error)
HOSPITAL ACUTE	2.269 (.455)*	2.628 (.512)*	0.359 (.324)
COMMUNITY	-.213 (.257)	-0.480 (.401)	-0.267 (.381)
CLINICIAN PRESENT	.740 (.244)*	-.197 (.325)	-.936 (.272)*
DISTANT PROVIDER	-.454 (.442)	-.330 (.515)	0.123 (.365)
constant	.266 (.229)	-.706 (.306)*	-.972 (.281)*
No. of observations		464	
Log likelihood		-391.66	
Pseudo R^2		.093	

Table 7: Marginal Effects, MNL Data Set 1

	Change in Probability of BC	**Change in Probability of SBC**	**Change in Probability of VDC**
With Respect to	coefficient (std. error)	coefficient (std.error)	coefficient (std. error)
HOSPITAL ACUTE	-0.090 (0.062)	-0.032 (0.169)	0.122 (173)
HOSPITAL NONACUTE	-0.143 (0.07)*	0.155 (0.147)	-0.012 (0.14)
COMMUNITY	0.102 (0.128)	-0.033 (0.163)	-0.068 (0.109)
MULTIPLE SERVICES	-0.121 (0.068)	0.099 (0.168)	0.022 (0.159)
GP	0.645 (0.196)*	-0.626 (0.190)*	-0.018 (0.147)
NHS TRUST	0.319 (0.171)	-0.313 (0.191)	-0.006 (0.151)
PURCHASER CONC.	0.014 (0.052)	0.030 (0.093)	0.044 (0.078)
PROVIDER CONC.	-0.027 (0.018)	0.043 (0.034)	-0.016 (0.029)
DISTANT PROVIDER	-0.163 (0.084)*	0.087 (0.210)	0.076 (0.204)

Table 8: Marginal Effects MNL Data Set 2

	Change in Probability of BC	**Change in Probability of SBC**	**Change in Probability of VDC**
With Respect to	coefficient (std. error)	coefficient (std.error)	coefficient (std. error)
HOSPITAL ACUTE	-0.278 (0.048)*	0.171 (0.13)	0.107 (0.125)
COMMUNITY	0.040 (0.059)	0.001 (0.101)	-0.041 (0.061)
CLINICIAN PRESENT	-0.082 (0.031)*	0.178 (0.074)*	-0.094 (0.073)
DISTANT PROVIDER	0.069 (0.043)	-0.071 (0.079)	0.002 (0.073)

Table 9: Coefficient Estimates Mixed MNL Data Set 1

Variable	**SBC relative to BC** coefficient (std. error)	**VDC relative to BC** coefficient (std. error)	**VDC relative to SBC** coefficient (std. error)
HOSPITAL ACUTE	3.951 (1.323)*	6.6343 (2.715)*	1.777 (1.508)
HOSPITAL NONACUTE	1.587 (1.132)	2.801 (1.880)	0.159 (1.468)
COMMUNITY	-1.330 (.967)	-1.046 (2.054)	-0.591 (1.726)
MULTIPLE SERVICES	3.437 (1.559)*	5.869 (2.679)*	1.347 (1.620)
GP	-7.175 (3.219)*	-3.596 (3.164)	1.764 (2.251)
NHS TRUST	-3.512 (2.032)	-0.095 (1.747)	2.306 (2.176)
PURCHASER CONC.	-.549 (1.312)	-1.572 (1.937)	-1.022 (1.362)
PROVIDER CONC.	.287 (.279)	0.016 (.333)	-0.263 (.253)
DISTANT PROVIDER	5.919 (2.318)*	6.860 (2.831)*	1.078 (1.106)
PURCHASER INTERCEPT 1		-4.499 (2.678)	
PURCHASER INTERCEPT 2		1.292 (1.476)	
PURCHASER INTERCEPT 1 VARIANCE		4.212 (2.751)	
PURCHASER INTERCEPT 2 VARIANCE		4.510 (1.698)*	
No. of observations		236	
Log likelihood		-129.18	

Table 10: Coefficient Estimates Mixed MNL Data Set 2

Variable	**SBC relative to BC** coefficient (std. error)	**VDC relative to BC** coefficient (std. error)	**VDC relative to SBC** coefficient (std. error)
HOSPITAL ACUTE	3.278 (.624)*	4.096 (.784)*	1.109 (.609)
COMMUNITY	-.030 (.363)	-1.273 (.581)*	-1.069 (.675)
CLINICIAN PRESENT	1.360 (.489)*	-0.064 (.760)	-1.274 (.695)
DISTANT PROVIDER	-.759 (.702)	0.414 (.852)	1.039 (.714)
PURCHASER INTERCEPT 1		-3.301 (1.056)*	
PURCHASER INTERCEPT 1		0.553 (0.496)	
PURCHASER INTERCEPT 1 VARIANCE		4.182 (0.912)*	
PURCHASER INTERCEPT 2 VARIANCE		2.738 (0.479)*	
No. of observations		464	
Log likelihood		-301.23	

Table 11: Marginal Effects, Mixed MNL Data Set 1

	Change in Probability of BC	**Change in Probability of SBC**	**Change in Probability of VDC**
With Respect to	coefficient (std. error)	coefficient (std.error)	coefficient (std. error)
HOSPITAL ACUTE	-0.075 (0.081)	-0.027 (0.204)	0.048 (0.213)
HOSPITAL NONACUTE	-0.040 (0.047)	0.029(0.104)	0.011 (0.107)
COMMUNITY	0.070 (0.104)	-0.071 (0.135)	0.001 (0.086)
MULTIPLE SERVICES	-0.058 (0.066)	0.015 (0.201)	0.043 (0.209)
GP	0.941 (0.154)*	-0.940 (0.14)*	-0.001 (0.081)
NHS TRUST	0.452 (0.213)*	-0.520 (0.229)*	0.068 (0.166)
PURCHASER CONC.	0.019 (0.054)	-0.013 (0.073)	-0.006 (0.048)
PROVIDER CONC.	-0.011 (0.012)	0.013 (0.017)	-0.002 (0.011)
DISTANT PROVIDER	-0.088 (0.089)	0.080 (0.160)	0.008 (0.154)

Table 12: Marginal Effects Mixed MNL Data Set 2

	Change in Probability of BC	**Change in Probability of SBC**	**Change in Probability of VDC**
With Respect to	coefficient (std. error)	coefficient (std.error)	coefficient (std. error)
HOSPITAL ACUTE	-0.227 (0.100)*	0.216 (0.112)*	0.011 (0.074)
COMMUNITY	0.021 (0.084)	-0.013 (0.094)	-0.008 (0.032)
CLINICIAN PRESENT	-0.128 (0.061)*	0.142 (0.073)*	-0.014 (0.033)
DISTANT PROVIDER	0.079 (0.074)	-0.094 (0.103)	0.015 (0.070)